

Advanced Transportation System Studies

Technical Area 3

Alternate Propulsion Subsystem Concepts

NAS8-39210

DCN 1-1-PP-02147

Interim Final Report

DRs – 4, 8, 9

Volume II – Final Report

April 1993

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Introduction

This is Volume II of the Final Report covering the first year's efforts under a NASA NRA – NAS8-39210, Advanced Transportation Systems Studies, Technical Area 3 (TA3), Alternate Propulsion Subsystem Concepts. There are three other Technical Areas contracted under the NRA. TA3 is managed through MSFC/PD with Bob Nixon as project manager. The contractor team is led by Rocketdyne with Thiokol and Workingsolutionz Software as team members. The contract is a one year contract, funded at \$692K, with two one year options with nominal funding of \$350K for the second year and ~\$1M for the third year.

The contract started on 6 April 1992, had an orientation meeting at MSFC on 29 April, its first study review on 17 June, its second study review on 1-2 October 1992, and its final review of the first year's efforts on 17 March 1993. Briefing books for each of the reviews were submitted and are available through MSFC/PD.

The objective of the contract is to provide definition of alternate propulsion systems for both earth-to-orbit (ETO) and in-space vehicles (upper stages and space transfer vehicles). For such propulsion systems, technical data to describe performance, weight, dimensions, etc. will be provided along with programmatic information such as cost, schedule, needed facilities, etc. Advanced technology and advanced development needs will be determined and provided.

A propulsion system database is also being developed which will be capable of including the systems examined under TA3 and any other existing or conceptual propulsion systems.

The contract results are reported in three parts:

Volume I – Executive Summary which overviews each of the contract tasks giving its objective, main results, and conclusions;

Volume II – Final Report (this volume) which references the individually delivered detailed Task reports (the detailed results are in the separate Task reports, not in Volume II) and fulfills the requirements of a place to report DRs 8 (Computer Aided Design Graphics and Analysis Data Documentation and Transfer) and 9 (New Technology Report), neither of which had any activity to report this year;

Volume III – Program Cost Estimates which contains DRs 5 (Work Breakdown Structure (WBS) and WBS Dictionary) and 6 (Program Cost Estimates Document).

Technical Discussion

The Alternate Propulsion Subsystem Concepts contract had five tasks defined for the first year. The tasks were: F-1A Restart Study, J-2S Restart Study, Propulsion Database Development, SSME Upper Stage Use, and CERs for Liquid Propellant Rocket Engines.

The two restart studies, F-1A and J-2S, generated program plans for restarting production of each engine. Special emphasis was placed on determining changes to individual parts due to obsolete materials, changes in OSHA and environmental concerns, new processes available, and any configuration changes to the engines.

The Propulsion Database Development task developed a database structure and format which is easy to use and modify while also being comprehensive in the level of detail available. The database structure included extensive engine information and allows for parametric data generation for conceptual engine concepts.

The SSME Upper Stage Use task examined the changes needed or desirable to use the SSME as an upper stage engine both in a second stage and in a translunar injection stage.

The CERs for Liquid Engines task developed qualitative parametric cost estimating relationships at the engine and major subassembly level for estimating development and production costs of chemical propulsion liquid rocket engines.

Figure 1 shows the schedule for the first year of the contract.

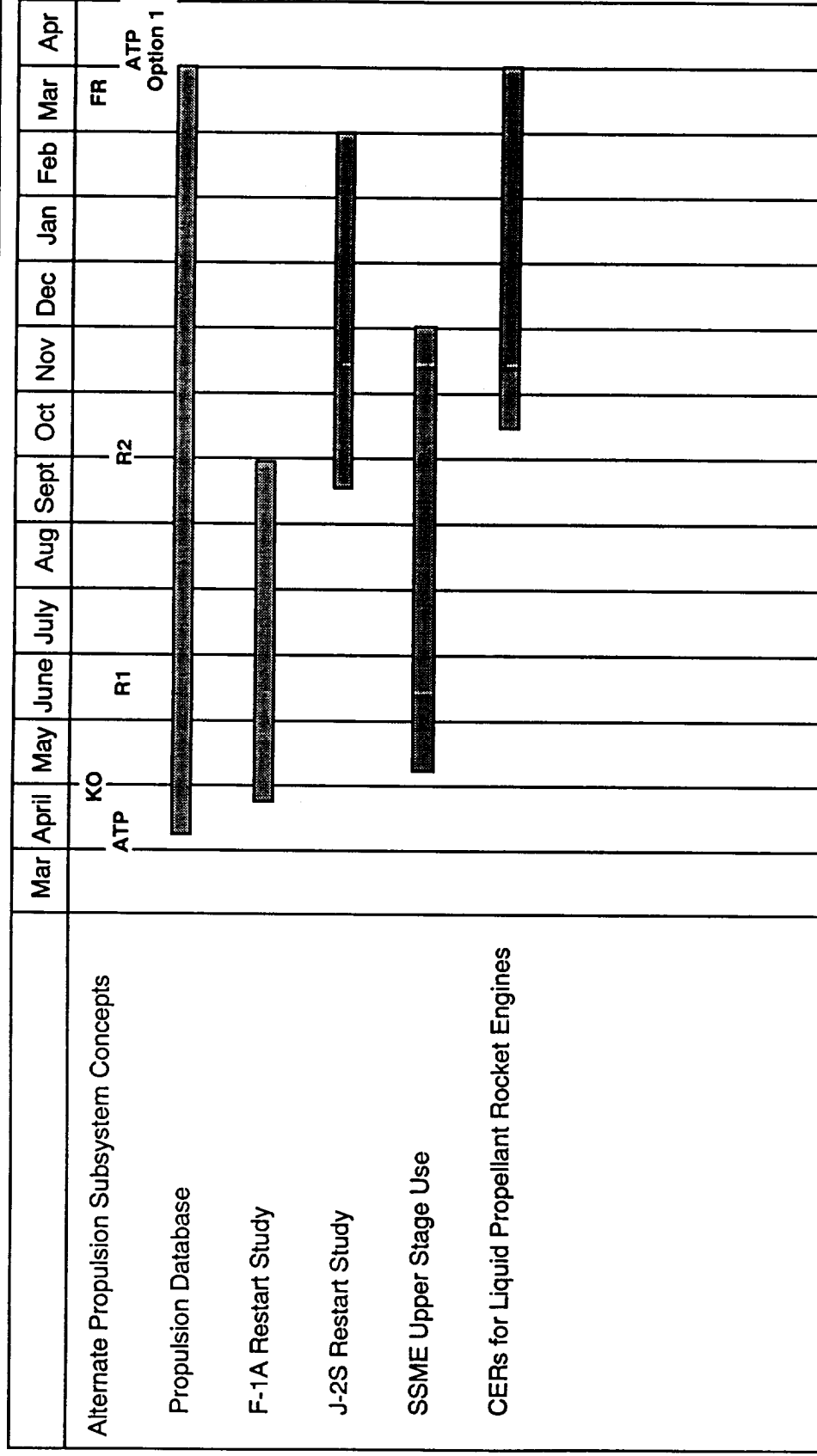
The detailed study results, with the data to support the conclusions from various analyses, are being reported as a series of five separate Final Task Reports. This distribution scheme was influenced by three factors:

1. each individual task focused on a different and well defined subject,
2. a user interested in one subject is not necessarily interested in any of the other subjects,
3. after a core distribution of 18 copies only 14 copies are available for general distribution.

Consequently, distribution of the details as a single report would require that a user only interested in one subject use up one of the 14 available copies, while distribution of separate detailed task reports would potentially produce a wider distribution by allowing a user to only request the reports on the tasks of particular interest to that user.

Figure 2 shows the reviews which took place during the year and the specific documentation available on either the reviews or the specific tasks. Also Volume I of this Final Report contains an Executive Summary of all five tasks with objectives, main results and conclusions, all under one cover. All the documentation is available from Bob Nixon (MSFC/PD).

**Advanced Transportation System Studies
Technical Area 3
Alternate Propulsion Subsystem Concepts**



ATP – Authority to Proceed
 KO – Kick-Off Meeting
 R# – Interim Review #
 FR – Final Review

Figure 1. First Year Schedule

<u>Meeting</u>	<u>Date</u>	<u>Location</u>	<u>Topics</u>	<u>Documentation</u>
Orientation Meeting	29 April 1992	MSFC	Study Plan	Briefing Book (DR-2) Study Plan (DR-1)
Formal Study Review	17 June 1992	MSFC	F-1A Restart Study SSME Upper Stage Use Database Development	Briefing Book (DR-2)
Informal Study Review	20 July 1992	Rocketdyne	F-1A Restart Study SSME Upper Stage Use	–
Informal Study Review	1 September 1992	Rocketdyne	F-1A Restart Study Planning for Future Study Tasks	–
Formal Study Review	1-2 October 1992	MSFC	F-1A Restart Study (Task Final Review) SSME Upper Stage Use Database Development	Briefing Book (DR-2) F-1A Restart Study Task Final Report (Part of DR-4)
Informal Study Review	21 October 1992	Rocketdyne	F-1A Restart Study SSME Upper Stage Use	–
Formal Study Review	17 March 1993	MSFC	J-2S Restart Study (Task Final Review) SSME Upper Stage Use (Task Final Review) Database Development (Review of First Year Work) CERs for Liquid Engines: (Final Task Review)	Briefing Book (DR-2) J-2S Restart Study Task Final Report (Part of DR-4) SSME Upper Stage Use Task Final Report (Part of DR-4) Database Development Task Final Report (Part of DR-4) CERs for Liquid Engines Task Final Report (Part of DR-4) Final Report Volumes I, II, and III (DRs 4, 5, 6, 8, 9)

Figure 2. First Year Reviews and Documentation

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Computer Aided Design Graphics and Analysis Data

Documentation and Transfer

DR-8

April 1993

There was no work conducted under this contract for which DR-8 applies.

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New Technology Report

DR-9

April 1993

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